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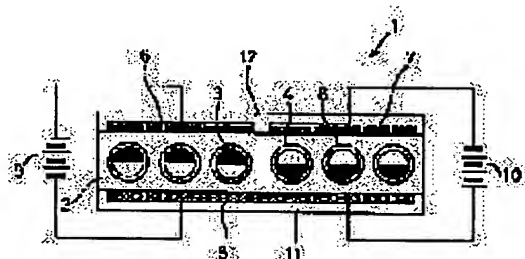
(54) DEVICE AND MEDIUM FOR IMAGE DISPLAY

(57)Abstract:

PROBLEM TO BE SOLVED: To improve rotation control over display particles with an external electric field, to quicken response at the time of image display operation, and to make a high-contrast image display by forming the display particles of a polarized dielectric substance.

SOLUTION: The display particles 3 are formed of white ferroelectric balls of barium titanate as a raw material and each ferroelectric ball has its upper hemispherical part colored in blue and its lower hemispherical part colored in white and is polarized so that there are more negative electric charges in the upper hemispherical part than in the lower hemispherical part. Therefore, display particles 3 which are sandwiched between an X electrode 5 and a Y electrode 6 are oriented according to the polarity of a power source 9. Namely, when the Y electrode 6 is an anode, the ball rotates so that the blue part where there are more electric charges approaches the Y electrode 6 and the ball becomes stable where the peak of the blue part is the closest to the Y electrode 6.

Further, display particles 3 held between the X electrode 5 and Y electrode 7 are oriented according to the polarity of the power source 10.



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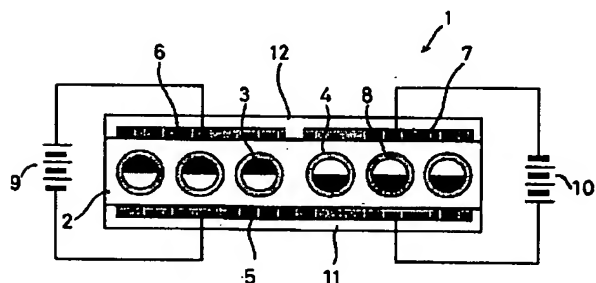
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(54) 【発明の名称】 画像表示装置及び画像表示媒体

(57) 【要約】

【課題】 外部電界による表示制御が良好で、応答が速く、コントラストが高いディスプレイパネルあるいは表示用媒体を提供すること。

【解決手段】 強誘電性材料からなる球状粒子を電気分極し、その分極方向に沿って色分けした構成の表示用粒子3を外部電界の作用で回転させることにより画像表示を行う。



【特許請求の範囲】

【請求項 1】 絶縁性液体中での帯電性及び色が異なる 2 種以上の領域により構成される表面を有する表示用粒子を、絶縁性液体中に分散し、

その表示用粒子に加えられる電界を制御して表示用粒子を回転させることにより画像表示を行う画像表示装置であって、

前記表示用粒子が、分極された誘電性物質からなることを特徴とする画像表示装置。

【請求項 2】 絶縁性液体中での帯電性及び色が異なる 2 種以上の領域により構成される表面を有する表示用粒子と、絶縁性液体とを内包する表示用カプセルを、支持体に保持し、

その表示用粒子に加えられる電界を制御して表示用粒子を回転させることにより画像表示を行うための画像表示媒体であって

前記表示用粒子が、分極された誘電性物質からなることを特徴とする画像表示媒体。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、画像表示装置及び画像表示媒体、詳しくは、色分けされた粒子を電界によって回転させることにより、文字、グラフィック、ビデオ等の画像情報を表示する、ディスプレイパネル、あるいは画像表示シート等の表示用媒体に関するものである。

【0002】

【従来の技術】従来、米国特許第 4, 143, 103 号、及び同第 4, 126, 854 号の各明細書に記載されているような、球状物質の半球づつが色分けされた構成の表示用粒子を用いて画像表示を行う粒子回転型ディスプレイが知られている。

【0003】前記表示用粒子は、例えば、球状のガラス等の半分を染料等で着色することによって得られる。したがって、1 つの表示用粒子の表面を構成する材質は、半球づつ異なるように構成される。

【0004】ここで、電気化学等の分野でよく知られているように、高絶縁性液体と粒子との界面には電気二重層が形成されるが、前記構成の表示用粒子は、その表面を構成する材料が半球ごとに異なっているため、高絶縁性液体中での帯電性、すなわち表面電荷量も半球ごとに異なり、その結果、高絶縁性液体中の表示用粒子には、電気双極子が形成される。

【0005】そして、前記構成の表示用粒子を分散した高絶縁性液体を、2 枚の絶縁性板により挟持し、その絶縁性板の一方に X 電極、他方に Y 電極を、互いに直交するように形成することにより、前記各公報に記載の粒子回転型ディスプレイが構成される。

【0006】前記構成の粒子回転型ディスプレイに於いては、適当な電源によって、前記 X 電極と Y 電極との間

に電圧を加え、その際発生する電界と前記電気双極子との相互作用で、前記表示用粒子の配向方向を制御することにより画像表示を行う。

【0007】

【発明が解決しようとする課題】しかしながら、上述した従来の粒子回転型ディスプレイに於いては、表示された画像のコントラストが不十分であった。

【0008】具体的には、電界の方向を逆転させたときに、回転が不完全な表示用粒子が多数存在していた。この原因としては、表示用粒子の電気双極子モーメントが小さく、外部電界に対する応答性が悪いことが挙げられる。

【0009】なぜなら、前記表示用粒子は、粒子の半球を着色する染料等により着色と電気双極子の形成とを行うので、大きな電気双極子モーメントを得るための帯電制御性と、良好な着色性とを兼ね備えた染料が選択される必要があるが、現実には、十分な帯電制御性と着色性を示す染料がなく、画像表示のために着色性を優先して帯電制御性に劣る染料を選択せざるを得ず、したがって、高絶縁性液体の中に於ける表示用粒子の帯電性が不十分となり、電気双極子モーメントが小さくなるからである。

【0010】本発明は、上述した問題点を解決するためになされたものであり、外部電界による表示制御が良好で、応答が速く、コントラストが高いディスプレイパネルあるいは表示用媒体を提供することを目的としている。

【0011】

【課題を解決するための手段】この目的を達成するために、本発明の請求項 1 に記載の画像表示装置は、絶縁性液体中での帯電性及び色が異なる 2 種以上の領域により構成される表面を有する表示用粒子を、絶縁性液体中に分散し、その表示用粒子に加えられる電界を制御して表示用粒子を回転させることにより画像表示を行うものであって、前記表示用粒子が、分極された誘電性物質からなることを特徴としている。

【0012】その分極された誘電性物質は、例えば、強誘電性物質を所定の電界下で電気分極させることにより得られる。

【0013】前記強誘電性物質は、外部の電界によって電気分極し、電界がなくなっても分極を維持するものであり、一般的に誘電率が高い物質である。具体的には、チタン酸バリウム、チタン酸鉛、ジルコニア酸鉛、チタン酸ジルコニア酸鉛、ニオブ酸リチウムなどが挙げられる。

【0014】このような誘電性物質からなる粒子を電気分極させると共に、その分極方向に応じて、その粒子表面が異なる色に配色されるように、その粒子表面の少なくとも一部を着色することにより表示用粒子が得られる。

【0015】この場合、分極によって電気双極子モーメントが形成されるため、粒子の着色に用いられる染料等は、帯電制御性を考慮する必要がなく、色のみによって選択することができる。したがって、大きな電気双極子モーメントと鮮明な色表示とを有する表示用粒子を得ることができ、外部電界による表示用粒子の回転及び配向制御が良好に行われ、画像表示動作時の応答が速く、表示画像のコントラストも高い。

【0016】また、請求項2記載の画像表示媒体は、絶縁性液体中での帯電性及び色が異なる2種以上の領域により構成される表面を有する表示用粒子と、絶縁性液体とを内包する表示用カプセルを支持体に保持し、その表示用粒子に加えられる電界を制御して表示用粒子を回転させることにより画像表示を行うためのものであって、前記表示用粒子が、分極された誘電性物質からなることを特徴としている。

【0017】前記表示用カプセルは、前記表示用粒子と絶縁性液体とを樹脂等の壁材で内包して構成した機能性粒子である。したがって、絶縁性液体を保持する容器等が不要となり、前記表示用カプセルを紙等の任意の支持体に保持させることができるため、応答が速く、高いコントラストの画像表示ができると共に、軽量で携帯性に優れ、取り扱いが容易な画像表示媒体が得られる。

【0018】

【発明の実施の形態】以下、本発明の実施の形態について、図面を参照しながら説明する。

【0019】図1は、本発明の第一の実施の形態である、画像表示装置としてのディスプレイ装置1について、その構造を示す図である。なお、本ディスプレイ装置1は、図1に於ける上側から画像表示が確認できる構成のものとする。

【0020】前記ディスプレイ装置1は、パネル基材2と、表示用粒子3と、絶縁性液体8と、X電極5と、Y電極6、7と、制御用電源9、10と、絶縁体基盤11と、絶縁保護層12とから構成される。

【0021】前記パネル基材2の内部には、多数の空隙4が設けられ、その各空隙4の内部には、絶縁性液体8と、表示用粒子3とが内包される。

【0022】前記パネル基材2は、表示用粒子3の着色が判別できる程度に透明で、かつパネルとしての強度が十分なものであれば良く、例えば、ポリエチレンあるいはポリスチレン等のプラスチック、エラストマー等を用いることができる。

【0023】前記パネル基材2に形成される空隙4の直径は、表示用粒子3が回転することが可能なように、表示用粒子3の平均粒径の1.5乃至2倍前後が好ましい。

【0024】前記絶縁性液体8としては、シリコンオイル、トルエン、キシレン、イソパラフィン等の高絶縁性液体が適している。

【0025】また、図1に於ける前記パネル基材2の上側及び下側には、X電極5とY電極6、7とが設けられる。

【0026】X電極5は、図1に於ける紙面と垂直方向に複数本配列して形成された直線状の電極パターンである。

【0027】Y電極6、7は、図1に於ける紙面と垂直方向に延伸された、直線状の電極パターンであり、ITO等の透明電極により構成される。

【0028】Y電極6、7とX電極5とは、互いに直交またはそれに近い角度で交差するように構成され、X電極5とY電極6の間、及びX電極5とY電極7の間には、制御用電源9及び10が接続される。したがって、Y電極6または7と、X電極5とが重なり合う交差部分は、前記パネル基材2の全面にわたって、いわゆるマトリックスを形成し、時分割で駆動される。この時分割駆動は、図示しないIC等の駆動素子によって行われる。

【0029】また、前記X電極5の周囲及び下部は、絶縁体基盤11によって覆われ、前記Y電極6、7の周囲及び上部は、透明な絶縁保護層12によって覆われる。前記絶縁体基盤11は特に透明でなくとも良く、ガラス、フェノール樹脂等が用いられ、前記絶縁保護層12としては、透明性の良好な、ポリカーボネート、ポリスチレン、アクリル等の合成樹脂やガラス等が用いられる。

【0030】前記表示用粒子3は、図2に示されるように、平均粒径0.05mm程度のチタン酸バリウムからなる白色の強誘電体ボールを原料として、その強誘電体ボールの上半球部分は青色を呈し（以下、青色部分と称する）、下半球部分は白色を呈する（以下、白色部分と称する）と共に、前記上半球部分は、前記下半球部分に比較して負電荷がより多数存在するように分極されて構成される。

【0031】したがって、X電極5とY電極6と間に挟まれた表示用粒子3は、電源9の極性に従って配向する。すなわち、図1に示すように、Y電極6が陽極である場合は、負電荷が多い青色部分がY電極6に近づくように回転し、その青色部分の頂点が前記Y電極6に最も近接した状態で安定する。

【0032】また、X電極5とY電極7との間に挟まれた表示用粒子3は、前記と同様に、電源10の極性に従って配向する。すなわち、Y電極7が陰極である場合は、正電荷が多い白色部分がY電極7に近づくように回転し、その白色部分の頂点が前記Y電極7に最も近接した状態で安定する。

【0033】そして、電源9、10の極性を、表示すべき画像データに対応してスイッチングすることにより、任意の画像を表示することができる。

【0034】ここで、前記表示用粒子3の製造方法について、図3乃至図5を用いて説明する。

【0035】図3は、電気分極工程を示す図である。

【0036】まず、誘電体ボール24をポリビニルアルコールの水溶液中に分散させ、この分散液を、スピンのコータによって下部電極板21の上にコーティングし、これを乾燥させることによって、下部電極板21の上にポリビニルアルコールの皮膜22が形成される。このとき、水分の蒸発によるポリビニルアルコール皮膜22の体積減少のため、図3に示すように、誘電体ボール24の上半分は露出し、下半分はポリビニルアルコール皮膜22に埋もれるように支持される。

【0037】そして、下部電極板21上に塗布された誘電体ボール24の前記上半分に対して上部電極板23を接触させた状態で、容器28に満たされた高絶縁性の液体26の中に浸し、上部電極板23と下部電極板21の間に電源25接続して、例えば、3kV程度の電圧を10時間程度印加することにより、誘電体ボール24を電気分極させる。その後、容器28から取り出し、上部電極板23を除去して十分に乾燥させる。

【0038】以上の方法により、上部が正極性、下部が負極性となるように分極された誘電体ボール24が下部電極板21に保持された、図4に示す分極プレート20が得られる。

【0039】次に、図5に示すように、蒸着装置30のサンプルテーブル31に前記分極プレート20を装着し、青色を呈する銅フタロシアニンの蒸着用材料33を加熱プレート32の上に乗せた後、蒸着装置30内を高真空状態に設定し、前記加熱プレート32で前記蒸着用材料33の加熱を行うことにより、誘電体ボール24の露出している半球部分の表面に、青色を呈する銅フタロシアニンの膜が蒸着される。

【0040】蒸着終了後、前記分極プレート32を蒸着装置30から取り出し、界面活性剤を添加したアセトンに浸すと、ポリビニルアルコール皮膜22が膨潤、軟化することにより、前記誘電体ボール24が前記ポリビニルアルコール皮膜から分離される。

【0041】以上の工程により、図2に示すような、大きな電気双極子モーメントに電気分極され、かつその分極方向に沿って2色を配された表示用粒子3が得られる。

【0042】前記のように得られた表示用粒子3を分散した2液性シリコンゴムを、コーティング装置を用いて、厚さ2mmの板状に成形し、約70℃で90分程度加熱硬化させる。そして、得られたシリコンゴム板をシリコンオイル中に約48時間浸し、シリコンゴムを膨張させることによって、シリコンオイルからなる絶縁性液体8で満たされた球状の空隙4の中に表示用粒子3を備えるパネル基材2が得られる。

【0043】続いて、前記パネル基材2を、透明電極からなるX電極5が形成されたガラス板である絶縁性基盤11と、透明電極からなるY電極6及び7が形成された

ガラス板である絶縁保護層12との間に挟み込むことにより、ディスプレイ装置1が得られる。

【0044】次に、本発明の第二の実施の形態である画像表示媒体40について、図面を参照して説明する。

【0045】図6に於いて、画像表示媒体40は、支持体41の表面にバインダー層42が形成され、そのバインダー層42には表示用カプセル44が保持されている。ここで、表示用カプセル44は、その下側半球部分がバインダー層42に埋もれることによりバインダー層42に保持され、上側半球部分は画像表示のために露出する。

【0046】前記表示用カプセル44は、表示用粒子43と高絶縁性液体45とを内包物として、この内包物が樹脂等の壁材に封入されて構成される。

【0047】前記支持体41としては、各種紙類、プラスチックフィルム、紙とフィルムの合成紙などが用いられる。

【0048】表示用粒子43及び高絶縁性液体45としては、前記第一の実施の形態と同様のものを使用することができる。

【0049】前記構成の表示用カプセル44は、以下のようにして得られる。

【0050】すなわち、界面活性剤等を用いて、表示用粒子43を高絶縁性の液体中に分散させ、この分散液とほぼ等量の、乳化剤が添加された水を、前記分散液と混合、攪拌することによって、O/W乳化物を得て、次に水相側から、前記壁材となる物質、例えば、メラミンホルムアルデヒド樹脂のプレポリマーを加え、約70℃で2時間、前記プレポリマーを硬化反応させることにより、前記構成の表示用カプセル44が得られる。

【0051】こうして得られた表示用カプセル44を、バインダー層42を構成するポリビニルピロリドン等の高分子物質の水溶液に分散させ、この分散液をコーティング装置を用いて支持体41に塗布し、これを乾燥させることにより、図6に示す画像表示媒体40が得られる。

【0052】前記構成の画像表示媒体40は、前記第一の実施の形態に於ける絶縁体基盤11及び絶縁保護層12の如く、マトリックス状に電極が形成された一組の板状部材またはフィルムの間に挟み込んで、画像信号に応じた電界を印加することにより、表示用粒子43を回転させて画像表示をすることができる。

【0053】また、所定の間隙を隔てて対向する2本の針電極をライン状に配置した構成の外部電界発生装置を用い、各針電極に対して画像信号に応じた電圧を印加しつつ前記間隙に前記画像表示媒体40を通すことによっても、その画像表示媒体40に任意の画像を表示することができ、画像を表示した画像表示媒体40は、印刷した紙等と同様に、軽量で携帯性に優れ、取り扱いが容易なものである。

【0054】尚、本発明は、以上に説明した実施の形態に限定されるものではなく、その要旨を変更しない範囲内に於いて、種々の変更が可能である。

【0055】例えば、電気分極と着色とは、上述した実施の形態の如く、別個に行われても良いし、同時に行われても良い。

【0056】また、表示用粒子表面の配色は、2色に限らず、それ以上でもよい。

【0057】

【発明の効果】以上説明したことから明かなように、本発明の請求項1に記載の画像表示装置によれば、外部電界による表示用粒子の回転制御が良好に行われ、画像表示動作時の応答が速く、高いコントラストの画像表示を行うことができる。

【0058】また、請求項2に記載の画像表示用媒体によれば、絶縁性液体を保持する容器等が不要となり、前記表示用カプセルを紙等の任意の支持体に保持させることができるため、応答が速く、高いコントラストの画像表示ができると共に、軽量で携帯性に優れ、取り扱いが容易な画像表示用媒体を提供することができる。

【図面の簡単な説明】

【図1】本発明の第一の実施の形態であるディスプレイ装置の概略構成を示す図である。

【図2】前記ディスプレイ装置に用いられる表示用粒子の拡大図である。

【図3】前記表示用粒子の作製方法を説明する図である。

【図4】前記表示用粒子の作製方法を説明する図である。

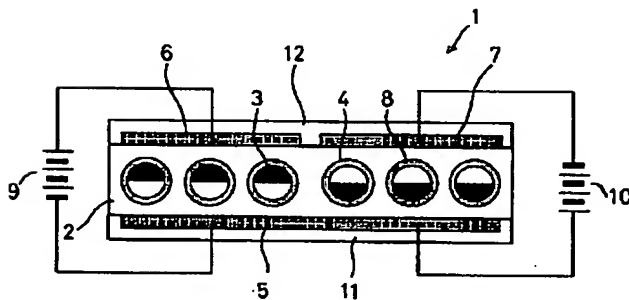
【図5】前記表示用粒子の作製方法を説明する図である。

【図6】本発明の第二の実施の形態である画像表示媒体の概略構成を示す図である。

【符号の説明】

- 1 ディスプレイ装置
- 2 パネル基材
- 3 表示用粒子
- 8 絶縁性液体
- 24 誘電体ボール
- 40 画像表示媒体
- 44 表示用カプセル

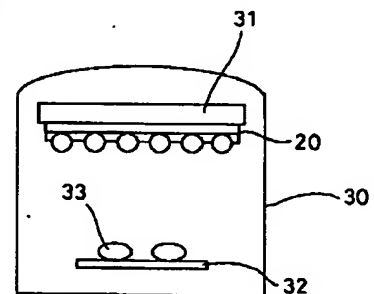
【図1】



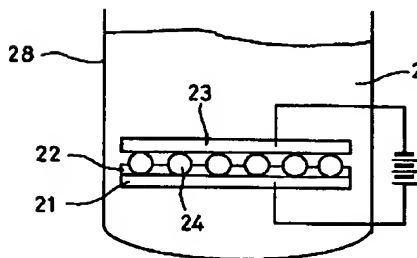
【図2】



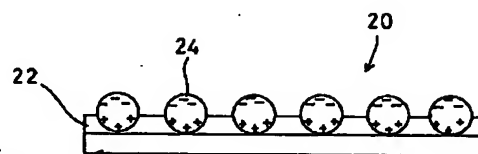
【図5】



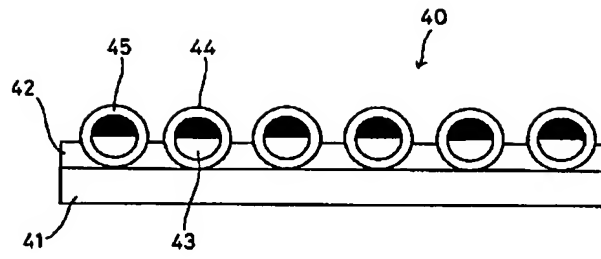
【図3】



【図4】



【図6】



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CLAIMS

[Claim(s)]

[Claim 1] The image display device which is the image display device which performs image display by distributing the particle for a display which has the front face constituted by two or more sorts of fields where the electrification nature and the color in the inside of an insulating liquid differ from each other in an insulating liquid, controlling the electric field added to the particle for a display, and rotating the particle for a display, and is characterized by for said particle for a display to consist of dielectric matter by which polarization was carried out.

[Claim 2] The image-display medium which is an image-display medium for perform image display by hold the capsule for a display which connotes the particle for a display which has the front face constitute by two or more sorts of fields where the electrification nature and the color in the inside of an insulating liquid differ from each other , and an insulating liquid to a base material , control the electric field add to the particle for a display , and rotate the particle for a display , and is characterize by for said particle for a display to consist of dielectric matter by which polarization be carried out .

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to media for a display, such as a display panel which displays image information, such as an alphabetic character, a graphic, and video, or an image display sheet, by rotating an image display device and an image display medium, and the particle classified by color in detail by electric field.

[0002]

[Description of the Prior Art] The particle rotation mold display which performs image display using the particle for a display of a configuration of that every [of spherical matter which is indicated by each specification of U.S. Pat. No. 4,143,103 and 4,126,854 / a semi-sphere] was classified by color conventionally is known.

[0003] Said particle for a display is obtained by coloring one half, such as glass of the shape for example, of a ball, with a color etc. Therefore, the quality of the material which constitutes the front face of one particle for a display is constituted so that it may differ a semi-sphere every.

[0004] Here, an electric double layer is formed in the interface of a high insulation liquid and a particle as fields, such as electrochemistry, are sufficient and it is known, but since the ingredients with which the particle for a display of said configuration constitutes the front face differ for every semi-sphere, it differs from each other for every semi-sphere, the electrification nature of surface charge, i.e., amount, in the inside of a high insulation liquid, consequently an electric dipole is formed in the particle for a display in a high insulation liquid.

[0005] And the high insulation liquid which distributed the particle for a display of said configuration is ****(ed) with two insulating plates, and the particle rotation mold display of a publication is constituted by said each official report by forming so that X electrode may be intersected perpendicularly with one side of the insulating plate and Y electrode may be mutually intersected perpendicularly with another side.

[0006] In the particle rotation mold display of said configuration, according to a suitable power source, an electrical potential difference is applied between said X electrodes and Y electrodes, it is the interaction of the electric field generated in that case, and said electric dipole, and image display is performed by controlling the direction of orientation of said particle for a display.

[0007]

[Problem(s) to be Solved by the Invention] However, in the conventional particle rotation mold display mentioned above, the contrast of the displayed image was inadequate.

[0008] When reversing the direction of electric field, specifically, many particles for a display with imperfect rotation existed. It is mentioned that the electric dipole moment of the particle for a display is small, and the responsibility over external electric field is bad as this cause.

[0009] Because, although the color which combines the electrification controllability for obtaining the big electric dipole moment and good coloring nature needs to be chosen since the color which colors the semi-sphere of a particle performs coloring and formation of an electric dipole, said particle for a display the color which there is no color which shows sufficient electrification controllability and coloring nature actually, gives priority to coloring nature for image display, and is inferior to an electrification controllability -- not choosing -- it is because it does not obtain,

therefore the electrification nature of the particle for a display in a high insulation liquid becomes inadequate and the electric dipole moment becomes small.

[0010] It is made in order that this invention may solve the trouble mentioned above, and the display control by external electric field is good, a response is quick, and contrast aims at offering a high display panel or the medium for a display.

[0011]

[Means for Solving the Problem] In order to attain this purpose, the image display device of this invention according to claim 1 The particle for a display which has the front face constituted by two or more sorts of fields where the electrification nature and the color in the inside of an insulating liquid differ from each other It is characterized by performing image display and said particle for a display consisting of dielectric matter by which polarization was carried out by distributing in an insulating liquid, controlling the electric field added to the particle for a display, and rotating the particle for a display.

[0012] The dielectric matter by which polarization was carried out is obtained by carrying out the electric polarization of the ferroelectric substance under predetermined electric field.

[0013] Said ferroelectric substance maintains polarization, even if it carries out electric polarization and electric field are lost by external electric field, and generally it is matter with a high dielectric constant. Specifically, barium titanate, lead titanate, zirconia ****, titanate-acid zirconia ****, lithium niobate, etc. are mentioned.

[0014] While carrying out the electric polarization of the particle which consists of such dielectric matter, the particle for a display is obtained by coloring a part of the particle front face [at least] so that it may be colored by the color from which the particle front face differs according to the direction of polarization.

[0015] In this case, since the electric dipole moment is formed of polarization, the color used for coloring of a particle does not need to take an electrification controllability into consideration, and can choose it only by the color. Therefore, the particle for a display which has the big electric dipole moment and clear color specification can be obtained, the rotation and orientation control of the particle for a display by external electric field are performed good, the response at the time of image display actuation is quick, and the contrast of a display image is also high.

[0016] Moreover, the particle for a display which has the front face where an image display medium according to claim 2 is constituted by two or more sorts of fields where the electrification nature and the color in the inside of an insulating liquid differ from each other, By holding the capsule for a display which connotes an insulating liquid to a base material, controlling the electric field added to the particle for a display, and rotating the particle for a display, it is for performing image display and is characterized by said particle for a display consisting of dielectric matter by which polarization was carried out.

[0017] Said capsule for a display is the functional particle which connoted and constituted said particle for a display and insulating liquid from wallplates, such as resin. Therefore, since the container holding an insulating liquid etc. can become unnecessary and said capsule for a display can be made to hold to the base material of arbitration, such as paper, while a response is quick and being able to perform image display of high contrast, it is lightweight, and excels in portability and an image display medium with easy handling is obtained.

[0018]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing.

[0019] Drawing 1 is drawing which is the gestalt of operation of the first of this invention and in which showing the structure about the display unit 1 as an image display device. In addition, let this display unit 1 be the thing of a configuration of that image display can be checked from the bottom in drawing 1.

[0020] Said display unit 1 consists of the panel base material 2, the particle 3 for a display, the insulating liquid 8, the X electrode 5, the Y electrodes 6 and 7, power sources 9 and 10 for control, an insulator base 11, and an insulating protective layer 12.

[0021] Many openings 4 are established in the interior of said panel base material 2, and the endocyst of the insulating liquid 8 and the particle 3 for a display is carried out to the interior of

each of that opening 4.

[0022] The reinforcement as a panel can use plastics, such as polyethylene or polystyrene, an elastomer, etc. transparently [said panel base material 2] to extent which can distinguish coloring of the particle 3 for a display that what is necessary is just fully.

[0023] The diameter of the opening 4 formed in said panel base material 2 has the desirable 1.5 thru/or 2 double forward back of the mean particle diameter of the particle 3 for a display so that the particle 3 for a display may be able to rotate.

[0024] As said insulating liquid 8, high insulation liquids, such as a silicone oil, toluene, a xylene, and isoparaffin, are suitable.

[0025] Moreover, the X electrode 5 and the Y electrodes 6 and 7 are formed in said panel base material 2 top and bottom in drawing 1 .

[0026] The X electrode 5 is the electrode pattern of the shape of a straight line which arranged two or more to the space and the perpendicular direction in drawing 1 , and was formed in them.

[0027] The Y electrodes 6 and 7 are the electrode patterns of the shape of a straight line extended by the space and the perpendicular direction in drawing 1 , and are constituted by transparent electrodes, such as ITO.

[0028] The Y electrodes 6 and 7 and the X electrode 5 are constituted so that it may cross at the include angle near a rectangular cross or it mutually, and between the X electrode 5 and the Y electrode 6 and between the X electrode 5 and the Y electrode 7, the power sources 9 and 10 for control are connected. Therefore, it goes over a part for the intersection which the Y electrodes 6 or 7 and the X electrode 5 overlap all over said panel base material 2, it forms the so-called matrix, and drives it by time sharing. This time-sharing drive is performed by driver elements, such as IC which is not illustrated.

[0029] Moreover, the perimeter and the lower part of said X electrode 5 are covered with the insulator base 11, and the perimeter and the upper part of said Y electrodes 6 and 7 are covered with the transparent insulating protective layer 12. Said especially insulator base 11 hopes that it is not transparent, glass, phenol resin, etc. are used, and synthetic resin, glass, etc., such as poly car PONETO with good transparency, polystyrene, and an acrylic, are used as said insulating protective layer 12.

[0030] Said particle 3 for a display uses as a raw material the ferroelectric ball of the white which consists of barium titanate of about 0.05mm of mean diameters, as shown in drawing 2 . a part for the Johan bulb of the ferroelectric ball -- blue -- presenting (a blue part being called hereafter) -- a bottom semi-sphere part -- white -- presenting (a white part being called hereafter) -- polarization is carried out and said top semi-sphere part is constituted so that a negative charge may recognize a large number existence more as compared with said bottom semi-sphere part.

[0031] Therefore, according to the polarity of a power source 9, orientation of the X electrode 5, the Y electrode 6, and the particle 3 for a display inserted in between is carried out. That is, as shown in drawing 1 , when the Y electrode 6 is an anode plate, it rotates so that a blue part with many negative charges may approach the Y electrode 6, and it is stabilized after the top-most vertices of the blue part have approached said Y electrode 6 most.

[0032] Moreover, according to the polarity of a power source 10, orientation of the particle 3 for a display inserted between the X electrode 5 and the Y electrode 7 is carried out like the above. That is, when the Y electrode 7 is cathode, it rotates so that a white part with much positive charge may approach the Y electrode 7, and it is stabilized after the top-most vertices of the white part have approached said Y electrode 7 most.

[0033] And the image of arbitration can be displayed by switching the polarity of power sources 9 and 10 corresponding to the image data which should be displayed.

[0034] Here, the manufacture approach of said particle 3 for a display is explained using drawing 3 thru/or drawing 5 .

[0035] Drawing 3 is drawing showing an electric polarization process.

[0036] First, the coat 22 of polyvinyl alcohol is formed on the lower electrode plate 21 by distributing the dielectric ball 24 in the water solution of polyvinyl alcohol, coating these dispersion liquid on the lower electrode plate 21 by the spin coater, and drying this. At this time,

for the volume decrease of the polyvinyl alcohol coat 22 by evaporation of moisture, as shown in drawing 3, the upper half of the dielectric ball 24 is exposed, and a lower half is supported so that it may be buried in the polyvinyl alcohol coat 22.

[0037] And the electric polarization of the dielectric ball 24 is carried out by dipping into the liquid 26 of high insulation filled by the container 28 where the up electrode plate 23 is contacted to said upper half of the dielectric ball 24 applied on the lower electrode plate 21, and connecting power-source 25 between the up electrode plate 23 and the lower electrode plate 21, for example, impressing the electrical potential difference of about 3kV for about 10 hours. Then, it takes out from a container 28, and the up electrode plate 23 is removed and is fully dried.

[0038] The polarization plate 20 with which the dielectric ball 24 by which polarization was carried out by the above approach so that the upper part might serve as straight polarity and the lower part might serve as negative polarity was held at the lower electrode plate 21 and which is shown in drawing 4 is obtained.

[0039] Next, as shown in drawing 5, the sample table 31 of vacuum evaporatio equipment 30 is equipped with said polarization plate 20. By setting the inside of vacuum evaporatio equipment 30 as a high vacuum condition, and heating said charge 33 of vacuum evaporatio material on said heating plate 32, after putting the charge 33 of vacuum evaporatio material of the copper phthalocyanine which presents blue on the heating plate 32 The film of the copper phthalocyanine which presents blue to the front face of the semi-sphere part which has exposed the dielectric ball 24 is vapor-deposited.

[0040] If it dips in the acetone which added the surface active agent, when it picks out said polarization plate 32 from vacuum evaporatio equipment 30 after vacuum evaporatio termination, and the polyvinyl alcohol coat 22 will swell and soften, said dielectric ball 24 is separated from said polyvinyl alcohol coat.

[0041] The particle 3 for a display which electric polarization was carried out [particle] to the big electric dipole moment as shown in drawing 2 by the above process, and had two colors allotted along the direction of polarization is obtained.

[0042] Using coating equipment, 2 acidity-or-alkalinity silicone rubber which distributed the particle 3 for a display obtained as mentioned above is fabricated to tabular [with a thickness of 2mm], and carries out heat hardening about 90 minutes at about 70 degrees C. And the panel base material 2 equipped with the particle 3 for a display into the spherical opening 4 filled with the insulating liquid 8 which consists of silicone oil is obtained by dipping the obtained silicone rubber plate into silicone oil for about 48 hours, and expanding silicone rubber.

[0043] Then, a display unit 1 is obtained by putting said panel base material 2 between the insulating base 11 which is the glass plate with which the X electrode 5 which consists of a transparent electrode was formed, and the insulating protective layer 12 which is the glass plate with which the Y electrodes 6 and 7 which consist of a transparent electrode were formed.

[0044] Next, the image display medium 40 which is the gestalt of operation of the second of this invention is explained with reference to a drawing.

[0045] In drawing 6, the binder layer 42 is formed in the front face of a base material 41, and, as for the image display medium 40, the capsule 44 for a display is held at the binder layer 42. Here, when the bottom semi-sphere part is buried in the binder layer 42, the capsule 44 for a display is held at the binder layer 42, and exposes a top semi-sphere part for image display.

[0046] By using the particle 43 for a display, and the high insulation liquid 45 as an endocyst object, this endocyst object is enclosed with wallplates, such as resin, and said capsule 44 for a display is constituted.

[0047] As said base material 41, various papers, plastic film, paper, the synthetic paper of a film, etc. are used.

[0048] The thing same as the particle 43 for a display and a high insulation liquid 45 as the gestalt of said first operation can be used.

[0049] The capsule 44 for a display of said configuration is the following, and is made and obtained.

[0050] Namely, by distributing the particle 43 for a display in the liquid of high insulation, mixing [said dispersion liquid and] and agitating the water with which these dispersion liquid and an

almost equivalent emulsifier were added using a surfactant etc. The capsule 44 for a display of said configuration is obtained by obtaining an O/W emulsification object, adding the prepolymer of the matter used as said wallplate, for example, melamine formaldehyde resin, and carrying out the hardening reaction of said prepolymer at about 70 degrees C from an aqueous-phase side, next, for 2 hours.

[0051] In this way, the image display medium 40 shown in drawing 6 is obtained by making the water solution of high polymers, such as a polyvinyl pyrrolidone which constitutes the binder layer 42, distribute the obtained capsule 44 for a display, applying these dispersion liquid to a base material 41 using coating equipment, and drying this.

[0052] Like the insulator base 11 in a gestalt and the insulating protective layer 12 of said first operation, by putting between the plate-like part material of a lot or films with which the electrode was formed in the shape of a matrix, and impressing the electric field according to a picture signal, the image display medium 40 of said configuration can rotate the particle 43 for a display, and can carry out image display.

[0053] Also moreover, by letting said image display medium 40 pass in said gap using the external electric-field generator of a configuration of having arranged two needle electrodes which separate a predetermined gap and counter in the shape of Rhine, impressing the electrical potential difference according to a picture signal to each needle electrode Like the printed paper, it is lightweight, and the image display medium 40 which could display the image of arbitration on the image display medium 40, and displayed the image is excellent in portability, and easy handling.

[0054] In addition, various modification is possible for this invention within limits which are not limited to the gestalt of the operation explained above and do not change the summary.

[0055] For example, like the gestalt of operation mentioned above, electric polarization and coloring may be performed separately and may be performed to coincidence.

[0056] Moreover, not only two colors but more than it is sufficient as the color scheme on the front face for a display of a particle.

[0057]

[Effect of the Invention] Like [it is ***** from having explained above and], according to the image display device of this invention according to claim 1, the roll control of the particle for a display by external electric field is performed good, the response at the time of image display actuation is quick, and image display of high contrast can be performed.

[0058] Moreover, since according to the medium for image display according to claim 2 the container holding an insulating liquid etc. can become unnecessary and said capsule for a display can be made to hold to the base material of arbitration, such as paper, while a response is quick and being able to perform image display of high contrast, it is lightweight, and excels in portability and handling can offer the easy medium for image display.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to media for a display, such as a display panel which displays image information, such as an alphabetic character, a graphic, and video, or an image display sheet, by rotating an image display device and an image display medium, and the particle classified by color in detail by electric field.

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PRIOR ART

[Description of the Prior Art] The particle rotation mold display which performs image display using the particle for a display of a configuration of that every [of spherical matter which is indicated by each specification of U.S. Pat. No. 4,143,103 and 4,126,854 / a semi-sphere] was classified by color conventionally is known.

[0003] Said particle for a display is obtained by coloring one half, such as glass of the shape for example, of a ball, with a color etc. Therefore, the quality of the material which constitutes the front face of one particle for a display is constituted so that it may differ a semi-sphere every.

[0004] Here, an electric double layer is formed in the interface of a high insulation liquid and a particle as fields, such as electrochemistry, are sufficient and it is known, but since the ingredients with which the particle for a display of said configuration constitutes the front face differ for every semi-sphere, it differs from each other for every semi-sphere, the electrification nature of surface charge, i.e., amount, in the inside of a high insulation liquid, consequently an electric dipole is formed in the particle for a display in a high insulation liquid.

[0005] And the high insulation liquid which distributed the particle for a display of said configuration is ****(ed) with two insulating plates, and the particle rotation mold display of a publication is constituted by said each official report by forming so that X electrode may be intersected perpendicularly with one side of the insulating plate and Y electrode may be mutually intersected perpendicularly with another side.

[0006] In the particle rotation mold display of said configuration, according to a suitable power source, an electrical potential difference is applied between said X electrodes and Y electrodes, it is the interaction of the electric field generated in that case, and said electric dipole, and image display is performed by controlling the direction of orientation of said particle for a display.

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EFFECT OF THE INVENTION

[Effect of the Invention] Like [it is ***** from having explained above and], according to the image display device of this invention according to claim 1, the roll control of the particle for a display by external electric field is performed good, the response at the time of image display actuation is quick, and image display of high contrast can be performed.

[0058] Moreover, since according to the medium for image display according to claim 2 the container holding an insulating liquid etc. can become unnecessary and said capsule for a display can be made to hold to the base material of arbitration, such as paper, while a response is quick and being able to perform image display of high contrast, it is lightweight, and excels in portability and handling can offer the easy medium for image display.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the conventional particle rotation mold display mentioned above, the contrast of the displayed image was inadequate.

[0008] When reversing the direction of electric field, specifically, many particles for a display with imperfect rotation existed. It is mentioned that the electric dipole moment of the particle for a display is small, and the responsibility over external electric field is bad as this cause.

[0009] Because, although the color which combines the electrification controllability for obtaining the big electric dipole moment and good coloring nature needs to be chosen since the color which colors the semi-sphere of a particle performs coloring and formation of an electric dipole, said particle for a display the color which there is no color which shows sufficient electrification controllability and coloring nature actually, gives priority to coloring nature for image display, and is inferior to an electrification controllability — not choosing — it is because it does not obtain, therefore the electrification nature of the particle for a display in a high insulation liquid becomes inadequate and the electric dipole moment becomes small.

[0010] It is made in order that this invention may solve the trouble mentioned above, and the display control by external electric field is good, a response is quick, and contrast aims at offering a high display panel or the medium for a display.

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MEANS

[Means for Solving the Problem] In order to attain this purpose, the image display device of this invention according to claim 1 The particle for a display which has the front face constituted by two or more sorts of fields where the electrification nature and the color in the inside of an insulating liquid differ from each other It is characterized by performing image display and said particle for a display consisting of dielectric matter by which polarization was carried out by distributing in an insulating liquid, controlling the electric field added to the particle for a display, and rotating the particle for a display.

[0012] The dielectric matter by which polarization was carried out is obtained by carrying out the electric polarization of the ferroelectric substance under predetermined electric field.

[0013] Said ferroelectric substance maintains polarization, even if it carries out electric polarization and electric field are lost by external electric field, and generally it is matter with a high dielectric constant. Specifically, barium titanate, lead titanate, zirconia ****, titanate-acid zirconia ****, lithium niobate, etc. are mentioned.

[0014] While carrying out the electric polarization of the particle which consists of such dielectric matter, the particle for a display is obtained by coloring a part of the particle front face [at least] so that it may be colored by the color from which the particle front face differs according to the direction of polarization.

[0015] In this case, since the electric dipole moment is formed of polarization, the color used for coloring of a particle does not need to take an electrification controllability into consideration, and can choose it only by the color. Therefore, the particle for a display which has the big electric dipole moment and clear color specification can be obtained, the rotation and orientation control of the particle for a display by external electric field are performed good, the response at the time of image display actuation is quick, and the contrast of a display image is also high.

[0016] Moreover, the particle for a display which has the front face where an image display medium according to claim 2 is constituted by two or more sorts of fields where the electrification nature and the color in the inside of an insulating liquid differ from each other, By holding the capsule for a display which connotes an insulating liquid to a base material, controlling the electric field added to the particle for a display, and rotating the particle for a display, it is for performing image display and is characterized by said particle for a display consisting of dielectric matter by which polarization was carried out.

[0017] Said capsule for a display is the functional particle which connoted and constituted said particle for a display and insulating liquid from wallplates, such as resin. Therefore, since the container holding an insulating liquid etc. can become unnecessary and said capsule for a display can be made to hold to the base material of arbitration, such as paper, while a response is quick and being able to perform image display of high contrast, it is lightweight, and excels in portability and an image display medium with easy handling is obtained.

[0018]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing.

[0019] Drawing 1 is drawing which is the gestalt of operation of the first of this invention and in which showing the structure about the display unit 1 as an image display device. In addition, let

this display unit 1 be the thing of a configuration of that image display can be checked from the bottom in drawing 1 .

[0020] Said display unit 1 consists of the panel base material 2, the particle 3 for a display, the insulating liquid 8, the X electrode 5, the Y electrodes 6 and 7, power sources 9 and 10 for control, an insulator base 11, and an insulating protective layer 12.

[0021] Many openings 4 are established in the interior of said panel base material 2, and the endocyst of the insulating liquid 8 and the particle 3 for a display is carried out to the interior of each of that opening 4.

[0022] The reinforcement as a panel can use plastics, such as polyethylene or polystyrene, an elastomer, etc. transparently [said panel base material 2] to extent which can distinguish coloring of the particle 3 for a display that what is necessary is just fully.

[0023] The diameter of the opening 4 formed in said panel base material 2 has the desirable 1.5 thru/or 2 double forward back of the mean particle diameter of the particle 3 for a display so that the particle 3 for a display may be able to rotate.

[0024] As said insulating liquid 8, high insulation liquids, such as a silicone oil, toluene, a xylene, and isoparaffin, are suitable.

[0025] Moreover, the X electrode 5 and the Y electrodes 6 and 7 are formed in said panel base material 2 top and bottom in drawing 1 .

[0026] The X electrode 5 is the electrode pattern of the shape of a straight line which arranged two or more to the space and the perpendicular direction in drawing 1 , and was formed in them.

[0027] The Y electrodes 6 and 7 are the electrode patterns of the shape of a straight line extended by the space and the perpendicular direction in drawing 1 , and are constituted by transparent electrodes, such as ITO.

[0028] The Y electrodes 6 and 7 and the X electrode 5 are constituted so that it may cross at the include angle near a rectangular cross or it mutually, and between the X electrode 5 and the Y electrode 6 and between the X electrode 5 and the Y electrode 7, the power sources 9 and 10 for control are connected. Therefore, it goes over a part for the intersection which the Y electrodes 6 or 7 and the X electrode 5 overlap all over said panel base material 2, it forms the so-called matrix, and drives it by time sharing. This time-sharing drive is performed by driver elements, such as IC which is not illustrated.

[0029] Moreover, the perimeter and the lower part of said X electrode 5 are covered with the insulator base 11, and the perimeter and the upper part of said Y electrodes 6 and 7 are covered with the transparent insulating protective layer 12. Said especially insulator base 11 hopes that it is not transparent, glass, phenol resin, etc. are used, and synthetic resin, glass, etc., such as poly car PONETO with good transparency, polystyrene, and an acrylic, are used as said insulating protective layer 12.

[0030] Said particle 3 for a display uses as a raw material the ferroelectric ball of the white which consists of barium titanate of about 0.05mm of mean diameters, as shown in drawing 2 . a part for the Johan bulb of the ferroelectric ball -- blue -- presenting (a blue part being called hereafter) -- a bottom semi-sphere part -- white -- presenting (a white part being called hereafter) -- polarization is carried out and said top semi-sphere part is constituted so that a negative charge may recognize a large number existence more as compared with said bottom semi-sphere part.

[0031] Therefore, according to the polarity of a power source 9, orientation of the X electrode 5, the Y electrode 6, and the particle 3 for a display inserted in between is carried out. That is, as shown in drawing 1 , when the Y electrode 6 is an anode plate, it rotates so that a blue part with many negative charges may approach the Y electrode 6, and it is stabilized after the top-most vertices of the blue part have approached said Y electrode 6 most.

[0032] Moreover, according to the polarity of a power source 10, orientation of the particle 3 for a display inserted between the X electrode 5 and the Y electrode 7 is carried out like the above. That is, when the Y electrode 7 is cathode, it rotates so that a white part with much positive charge may approach the Y electrode 7, and it is stabilized after the top-most vertices of the white part have approached said Y electrode 7 most.

[0033] And the image of arbitration can be displayed by switching the polarity of power sources

9 and 10 corresponding to the image data which should be displayed.

[0034] Here, the manufacture approach of said particle 3 for a display is explained using drawing 3 thru/or drawing 5.

[0035] Drawing 3 is drawing showing an electric polarization process.

[0036] First, the coat 22 of polyvinyl alcohol is formed on the lower electrode plate 21 by distributing the dielectric ball 24 in the water solution of polyvinyl alcohol, coating these dispersion liquid on the lower electrode plate 21 by the spin coater, and drying this. At this time, for the volume decrease of the polyvinyl alcohol coat 22 by evaporation of moisture, as shown in drawing 3, the upper half of the dielectric ball 24 is exposed, and a lower half is supported so that it may be buried in the polyvinyl alcohol coat 22.

[0037] And the electric polarization of the dielectric ball 24 is carried out by dipping into the liquid 26 of high insulation filled by the container 28 where the up electrode plate 23 is contacted to said upper half of the dielectric ball 24 applied on the lower electrode plate 21, and connecting power-source 25 between the up electrode plate 23 and the lower electrode plate 21, for example, impressing the electrical potential difference of about 3kV for about 10 hours. Then, it takes out from a container 28, and the up electrode plate 23 is removed and is fully dried.

[0038] The polarization plate 20 with which the dielectric ball 24 by which polarization was carried out by the above approach so that the upper part might serve as straight polarity and the lower part might serve as negative polarity was held at the lower electrode plate 21 and which is shown in drawing 4 is obtained.

[0039] Next, as shown in drawing 5, the sample table 31 of vacuum evaporatio equipment 30 is equipped with said polarization plate 20. By setting the inside of vacuum evaporatio equipment 30 as a high vacuum condition, and heating said charge 33 of vacuum evaporatio material on said heating plate 32, after putting the charge 33 of vacuum evaporatio material of the copper phthalocyanine which presents blue on the heating plate 32. The film of the copper phthalocyanine which presents blue to the front face of the semi-sphere part which has exposed the dielectric ball 24 is vapor-deposited.

[0040] If it dips in the acetone which added the surface active agent, when it picks out said polarization plate 32 from vacuum evaporatio equipment 30 after vacuum evaporatio termination, and the polyvinyl alcohol coat 22 will swell and soften, said dielectric ball 24 is separated from said polyvinyl alcohol coat.

[0041] The particle 3 for a display which electric polarization was carried out [particle] to the big electric dipole moment as shown in drawing 2 by the above process, and had two colors allotted along the direction of polarization is obtained.

[0042] Using coating equipment, 2 acidity-or-alkalinity silicone rubber which distributed the particle 3 for a display obtained as mentioned above is fabricated to tabular [with a thickness of 2mm], and carries out heat hardening about 90 minutes at about 70 degrees C. And the panel base material 2 equipped with the particle 3 for a display into the spherical opening 4 filled with the insulating liquid 8 which consists of silicone oil is obtained by dipping the obtained silicone rubber plate into silicone oil for about 48 hours, and expanding silicone rubber.

[0043] Then, a display unit 1 is obtained by putting said panel base material 2 between the insulating base 11 which is the glass plate with which the X electrode 5 which consists of a transparent electrode was formed, and the insulating protective layer 12 which is the glass plate with which the Y electrodes 6 and 7 which consist of a transparent electrode were formed.

[0044] Next, the image display medium 40 which is the gestalt of operation of the second of this invention is explained with reference to a drawing.

[0045] In drawing 6, the binder layer 42 is formed in the front face of a base material 41, and, as for the image display medium 40, the capsule 44 for a display is held at the binder layer 42. Here, when the bottom semi-sphere part is buried in the binder layer 42, the capsule 44 for a display is held at the binder layer 42, and exposes a top semi-sphere part for image display.

[0046] By using the particle 43 for a display, and the high insulation liquid 45 as an endocyst object, this endocyst object is enclosed with wallplates, such as resin, and said capsule 44 for a display is constituted.

[0047] As said base material 41, various papers, plastic film, paper, the synthetic paper of a film,

etc. are used.

[0048] The thing same as the particle 43 for a display and a high insulation liquid 45 as the gestalt of said first operation can be used.

[0049] The capsule 44 for a display of said configuration is the following, and is made and obtained.

[0050] Namely, by distributing the particle 43 for a display in the liquid of high insulation, mixing [said dispersion liquid and] and agitating the water with which these dispersion liquid and an almost equivalent emulsifier were added using a surfactant etc. The capsule 44 for a display of said configuration is obtained by obtaining an O/W emulsification object, adding the prepolymer of the matter used as said wallplate, for example, melamine formaldehyde resin, and carrying out the hardening reaction of said prepolymer at about 70 degrees C from an aqueous-phase side, next, for 2 hours.

[0051] In this way, the image display medium 40 shown in drawing 6 is obtained by making the water solution of high polymers, such as a polyvinyl pyrrolidone which constitutes the binder layer 42, distribute the obtained capsule 44 for a display, applying these dispersion liquid to a base material 41 using coating equipment, and drying this.

[0052] Like the insulator base 11 in a gestalt and the insulating protective layer 12 of said first operation, by putting between the plate-like part material of a lot or films with which the electrode was formed in the shape of a matrix, and impressing the electric field according to a picture signal, the image display medium 40 of said configuration can rotate the particle 43 for a display, and can carry out image display.

[0053] Also moreover, by letting said image display medium 40 pass in said gap using the external electric-field generator of a configuration of having arranged two needle electrodes which separate a predetermined gap and counter in the shape of Rhine, impressing the electrical potential difference according to a picture signal to each needle electrode Like the printed paper, it is lightweight, and the image display medium 40 which could display the image of arbitration on the image display medium 40, and displayed the image is excellent in portability, and easy handling.

[0054] In addition, various modification is possible for this invention within limits which are not limited to the gestalt of the operation explained above and do not change the summary.

[0055] For example, like the gestalt of operation mentioned above, electric polarization and coloring may be performed separately and may be performed to coincidence.

[0056] Moreover, not only two colors but more than it is sufficient as the color scheme on the front face for a display of a particle.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the outline configuration of the display unit which is the gestalt of operation of the first of this invention.

[Drawing 2] It is the enlarged drawing of the particle for a display used for said display unit.

[Drawing 3] It is drawing explaining the production approach of said particle for a display.

[Drawing 4] It is drawing explaining the production approach of said particle for a display.

[Drawing 5] It is drawing explaining the production approach of said particle for a display.

[Drawing 6] It is drawing showing the outline configuration of the image display medium which is the gestalt of operation of the second of this invention.

[Description of Notations]

1 Display Unit

2 Panel Base Material

3 Particle for Display

8 Insulating Liquid

24 Dielectric Ball

40 Image Display Medium

44 Capsule for Display

[Translation done.]

* NOTICES *

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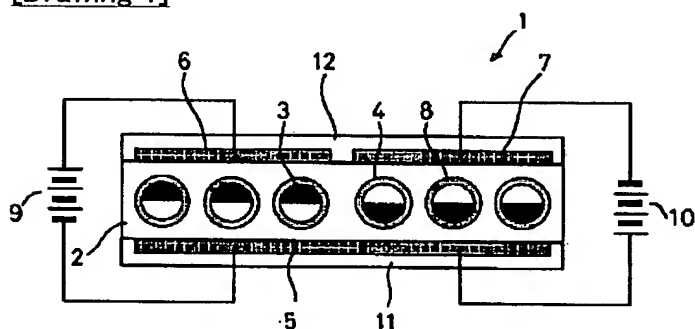
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DRAWINGS

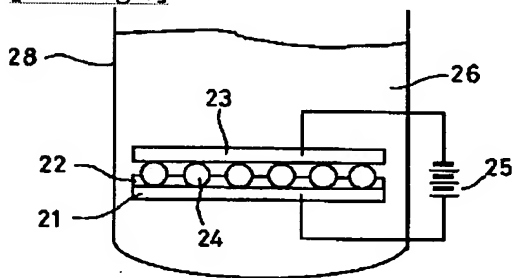
[Drawing 1]



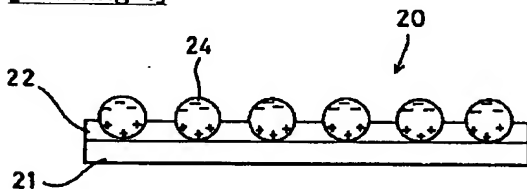
[Drawing 2]



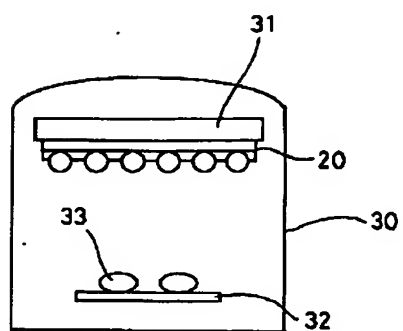
[Drawing 3]



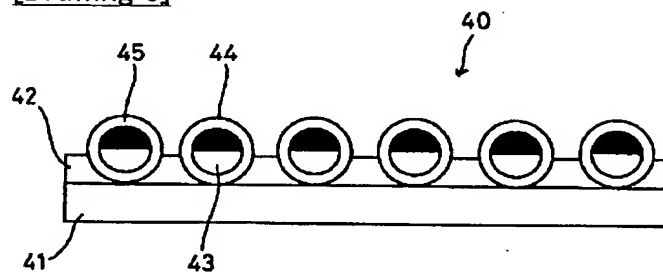
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]